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INSECT PREVENTION and CONTROL in ROUGH RICE

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Market Quality Research Division

WARNING

The Miller amendment to the Food, Drug, and Cosmetic Act (Federal law 518, 83d Congress) provides for establishment of safe tolerances for residues of useful insecticides on raw agricultural products, including rough rice. Most insecticides leave a residue. They should be used on or around rice only if tolerances, or exemptions from the requirements for a tolerance, have been established for that insecticide on rice; and they should be used only in such a way that their residues will not exceed their respective tolerances.

When rice is fumigated repeatedly with methyl bromide, fixed bromide residues accumulate in the grain. After several fumigations, the residue will exceed the tolerance. Do not use methyl bromide or other bromine-bearing fumigant on rice unless it has not been previously fumigated, or unless chemical analysis shows that it does not already contain so much residue that another fumigation will cause the total to exceed the legal tolerance.

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INSECT PREVENTION AND CONTROL IN ROUGH RICE

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Insect infestation and damage is one of the major problems in storing rough rice. The U.S. Department of Agriculture has conducted studies during the past few years on these problems. Although much remains to be learned, the measures that have been developed will give

satisfactory results under most conditions if they are carried out properly.

The studies were conducted in the Texas rice production and storage area, but the suggestions may be applied to storage of rough rice in any area.

Summary of Suggestions for Control

- ▶ Clean the warehouse inside and outside before storing rice in it. Burn or remove all refuse.
- ▶ Apply a DDT or malathion residual spray after cleanup and before any rice is stored. Do not apply DDT to surfaces that will be in contact with the rice.
- ▶ Apply malathion or synergized pyrethrum to the rice as it goes into storage. This will protect insect-free rice from becoming infested during storage.
- ▶ To control an already existing infestation, fumigate the rice.

The Insect Problem

Contributing Factors

Many warehouses are continually being reinfested from colonies of insects in old rice lodged on or in ledges, beams, window sills, elevators, elevator wells, conveyors, and other places, as well as in rice, other grains, or animal feeds spilled under or near the warehouse.

The long warm season, the mild winters, and the humid atmospheric conditions typical of the areas where rice is grown favor the development of insects and result in heavy infestations. Rough rice is

often stored in warehouses or flat storages of such loose construction that fumigation is impossible.

Insects Involved

Some 30 species of insects have been found infesting stored rice and rice products, but the following 9 are the only ones that may be considered as serious pests of rough rice.

The lesser grain borer (*Rhyzopertha dominica* (F.)), the rice weevil (*Sitophilus oryzae* (L.)), and the Angoumois grain moth

(*Sitotroga cerealella* (Oliv.)), bore into the rice kernels, at times almost completely destroying them.

The cadelle (*Tenebroides mauritanicus* (L.)), the saw-toothed grain beetle (*Oryzaephilus surinamensis* (L.)), the flat grain beetle (*Cryptolestes pusillus* (Schon.)), the Indian-meal moth (*Plodia interpunctella* (Hbn.)), the almond

moth (*Ephestia cautella* (Wlkr.)), and the rice moth (*Corcyra cephalonica* (Staint.)), feed on broken grains.

Brief accounts of the life histories and habits of these and other stored-grain insects can be found in Farmers' Bulletin No. 1260, "Stored Grain Pests," issued by the U.S. Department of Agriculture.

Treatment of Warehouse

Cleanup of Warehouse and Environs

Before storing rough rice, either in sacks or in bulk, thoroughly clean the warehouse, bins, and surroundings. Clean up trash and remains of rice, other grain, or animal feed, inside and around the warehouse. Pay particular attention to areas underneath loading platforms and beneath the building if it is a raised structure. Inside the building, be sure to clean ledges, beams, window sills, and crevices. Material often collects in those places, becomes heavily infested with insects, and serves as a source of infestation for the next crop of rice brought into the warehouse.

Handling equipment is quite often overlooked in the cleanup operation. Make certain that no rice remains in elevators, conveyors, or elevator wells.

Burn, bury, or remove from the premises all refuse collected in these operations.

Residual Spray

Apply a residual spray after the warehouse is cleaned, preferably 1

or 2 weeks before any rice is brought in. Spray the floor, walls, beams, and ceiling of the empty warehouse or bin. Spray the outside walls of the building to a height of 6 or 8 feet, or to the eaves if they are not too high to reach with the sprayer. Spray the ground to a distance of about 6 feet from the building where possible. If the warehouse is a raised structure, spray the pillars and at least a few feet of the underside around them and around the edges of the building where possible.

Apply a 5-percent DDT or 3-percent malathion emulsion spray at the rate of about 2 gallons per 1,000 square feet, or just before the point of runoff. Use the malathion spray on surfaces that will be in contact with the rice, because there is no tolerance for DDT on rice; all other surfaces may be sprayed with either DDT or malathion. If there is much area to cover, it is best to use a power sprayer with enough pressure to force the spray into cracks and protected places.

Treatment of Rough Rice

Proper timing, selection, and application of insecticides for prevention and control of insect infestations in rough rice are most important if the quality of the rice

is to be maintained during storage. Insect-free rice that is to be stored for 3 months or longer should be sprayed with an insecticide as the rice goes into storage. Such treat-

ments will protect the rice against invasion by insects but are not very effective if the insects are already established in the grain. Fumigation is the only way to eliminate an existing infestation. Rice with a moderate to heavy insect infestation should be fumigated before it is moved and then sprayed with an insecticide. With proper application, the level of insecticide needed for protection is obtained without exceeding any established tolerances.

Bulk Treatment

The bulk treatment consists of spraying rough rice as it is placed in the bin or before it is sacked. A convenient place to locate the spray nozzle is at the intake end of a conveyor. It is advisable to place a canvas hood on a frame over the area of the spray nozzle to reduce air currents and prevent excessive loss of the spray. The spray should be coarse. It should be applied uniformly. The size of the nozzle opening and the operating pressure on the spray line must be calibrated with the rate of flow of rice on the conveyor to give the proper rate of application.¹ A typical power sprayer is shown in figure 1.

Premium-grade malathion and pyrethrum in combination with piperonyl butoxide have been approved for use on rice, providing the residue is within the established tolerance of 8 p.p.m. (parts per million) for malathion, 3 p.p.m. for pyrethrum, and 20 p.p.m. for piperonyl butoxide.

The calculated deposits from the rates of application given below exceed the tolerance. However, because some insecticide is lost during application, the actual residues are

well within the established tolerances.

The recommended formulations and quantities to add to 5 gallons of water required for treating 1,000 bushels of rice are:

Emulsifiable concentrate containing 57 percent of premium-grade malathion	1 pint
Emulsifiable concentrate containing 6 percent of pyrethrins and 60 percent of piperonyl butoxide	3 pints

Fumigation

Fumigation is effective only in tight structures such as concrete silos, steel buildings with sealed joints, or tight wooden structures with concrete floors. The fumigation must be conducted only by experienced operators who know how to do the job effectively and safely.

Tolerances have been established for fumigants on rice under section 408 (Miller amendment) of the Federal Food, Drug, and Cosmetic Act, as follows:

<i>Fumigant</i>	<i>Tolerance</i> (p.p.m.)
Calcium cyanide.....	25
Hydrogen cyanide.....	100
Methyl bromide.....	*50
Ethylene dibromide.....	*50

* Calculated as inorganic bromide.

The following fumigants have been exempted from the requirements of a tolerance and, therefore, can also be used: Sulfur dioxide, carbon tetrachloride, carbon disulfide, ethylene dichloride, chloropicrin, chloroform, and methylene chloride.

Dosages for the foregoing fumigants will vary, depending on local conditions, the condition of the rice, and the tightness of the structure. Follow closely the recommendations on the label.

Three fumigations with methyl bromide may result in inorganic bromide residues in excess of 50 p.p.m. Before fumigating rice for the third time with methyl bromide, make a chemical analysis to deter-

¹ The method of calibrating the sprayer is given in "Method and Equipment for Bulk Treatment of Grain Against Insects." U.S. Dept. Agr. Mktg. Bul. 20, 7 pp., illus., October 1962.



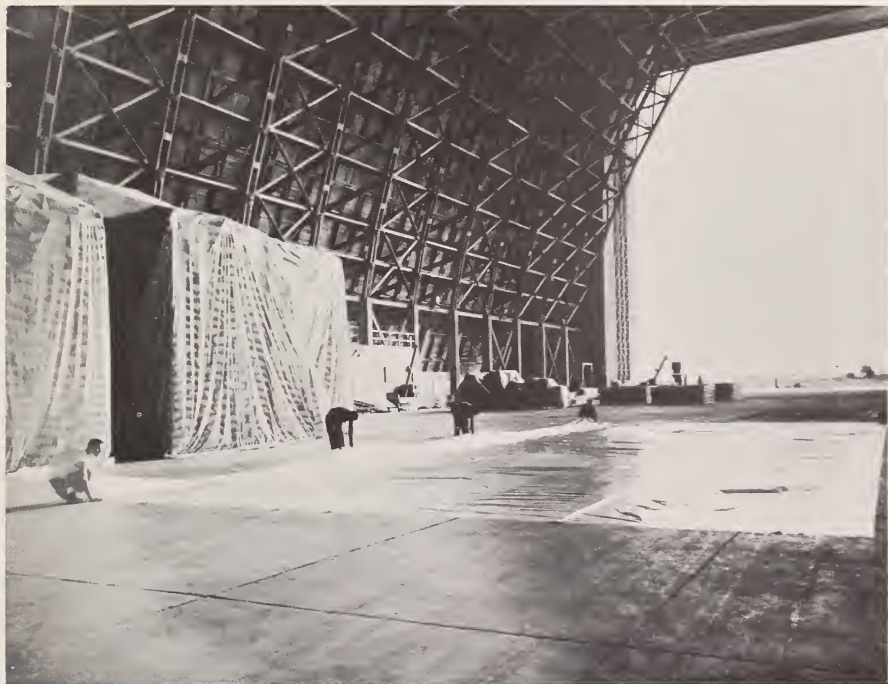
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Figure 1.—Power sprayer that consists of a nylon roller pump, equipped with leather seals (leather is not affected by the action of the insecticide), $\frac{1}{3}$ - to $\frac{1}{2}$ -horsepower, 110-volt motor, 8-foot suction hose with removable suction strainer, 7-foot bypass hose, $\frac{1}{2}$ -inch pressure regulator, pressure gage, shutoff valve, 20-foot pressure hose, spray nozzle, and nozzle bracket, all mounted on a steel base, which is attached to a barrel of the insecticide.

mine the existing level of inorganic bromide residue.

In warehouses that are too loosely constructed for successful fumigation or in large storages where it would be impractical to fumigate the entire space, it is advantageous to fumigate individual stacks of sacked rice under a gastight sheet of plastic (fig. 2). In recent research,

fumigation under plastic sheets with 3 pounds of hydrogen cyanide per 1,000 cubic feet, and an additional 2 pounds per 1,000 cubic feet one month later, resulted in concentrations that remained lethal for several months. The plastic covers may be left in place to protect the stacks from dirt, flying insects, and birds.



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FIGURE 2.—Stacks of rice covered by sheets of polyethylene plastic, and a sheet of plastic laid out ready to cover another stack.

Previous Publications of the Stored-Product Insects Branch Relating to Insects in Rice

- Studies on Fumigating Rice in Flat Storage by the Forced Circulation Method. Reprint from *Rice Journal*, March 1957.
- Studies on the Fumigation of Bulk Rice in Freight Cars. Reprint from *Rice Journal*, May 1957.
- Studies on the Fumigation of Sacked Rice Under Gastight Tarpaulins. Reprint from *Rice Journal*, August 1957.
- Controlling Insect Pests of Stored Rice. U.S. Dept. Agr. Handb. 129, 30 pp., illus. October 1957. (Out of print.)²
- Field Tests of Protectants on Rough Rice. Reprint from *Rice Journal*, May 1961.
- Infrared Radiation for the Control of Immature Insects in Kernels of Rough Rice. U.S. Dept. Agr. AMS-445, 10 pp. May 1961.
- Fumigation of Sacked Rice Under Plastic Film With Hydrogen Cyanide for Long-Term Protection. Reprint from *Rice Journal*, July 1961.
- Drying Rough Rice With Infrared Radiation. U.S. Dept. Agr. AMS-467, 28 pp., illus. January 1962.

²This handbook may be consulted in a large library. A revised edition of the handbook is being prepared for publication.